1.9 Designing a Site-Specific PV System

The ideal site for the installation of a rooftop solar array will have a suitably large roof area facing the equator, pitched at the angle of the site's latitude and with no trees or other obstructions nearby. However, often sites will have less than ideal roof spaces not facing the ideal direction and possibly having some shading. The designer of the PV system must understand how any proposed design is best able to combine the site conditions identified in the site assessment and the system owner's expectations and finances to produce an acceptable outcome.

REMEMBER

For the Southern Hemisphere, the optimal module orientation is facing the equator, i.e. facing north.

Optimal module tilt angle for a location is equal to the angle of latitude for that location, with an allowable tolerance of up to 10°. E.g. the latitude of Sydney is 34° and so the optimal tilt angle is 34°±10°.

Sub-optimal Module Tilt

The optimal annual yield is achieved by tilting a PV module at the same angle as the latitude of the site. Situations where the modules may be tilted at a sub-optimal angle include:

- A pitched roof where it is cheaper and/or more aesthetically pleasing to mount the modules flush to the roof, but where this may result in the modules not being optimally tilted.
- Flat roofs with limited space for multiple module rows, where mounting modules in rows at a lower tilt angle (i.e. flatter to the roof) will produce shorter shadows so that the rows can be spaced closer together. This could result in another row of modules being able to fit on the roof. There will be a higher cost to install the extra row of modules, but the overall yield is likely to be higher. Remember that modules need a minimum tilt of 10° for self-cleaning.
- Sites with higher demand in one season than in another. Sites that use more electricity in the winter (e.g. for heating) may benefit from a higher array tilt that will generate more electricity in the winter. Sites that use more electricity in the summer (e.g. for cooling or irrigation) may benefit from a lower tilt, generating more electricity in summer. The effects of tilt on the summer and winter generation should be carefully calculated and weighed up for these scenarios.

AUSTRALIAN STANDARDS

AS/NZS 5033:2014 Clause 2.1.6 states that all PV modules in a single string must face the same direction (i.e. be within 5° of the same tilt and azimuth).

Modules Facing Different Directions

In the Southern Hemisphere, the optimal annual yield is achieved by facing the modules north. In the Northern Hemisphere, the optimal annual yield is achieved by facing the modules south. If the array does not face the ideal direction, the annual yield of the array will be less than optimal. Situations where the modules may be oriented in a different direction include:

- A roof without an optimal aspect or with an optimal aspect that is too small for the array.
- A roof of limited space facing different directions, which could have strings of modules installed in different directions to each other (e.g. a string of modules facing north and another string of modules facing west). To achieve the highest yield in this situation, the array may need an inverter with multiple MPPTs or to use micro-inverters. This could increase the equipment cost of the system. The system designer can provide system yield calculations for the performance of the array spread over different roof planes.
- Sites that experience regular cloudy or foggy weather in the morning or afternoon. These may benefit from orientating the modules so that they maximise solar generation in the sunny periods. For example, a site in the Southern Hemisphere that regularly experiences morning fogs could benefit from orientating the modules north-west to maximise capturing the afternoon Sun.

DID YOU KNOW?

Fronius, an inverter manufacturer, has found that there may be less than 1% loss in power when using a single-MPPT inverter with an east–west array (i.e. one string facing east and one string facing west, paralleled into a single MPPT), compared with identical east and west strings connected to separate MPPTs. As all modules in a string have the same orientation, this arrangement complies with the relevant standards.